CLAIMS

What is claimed is:

1. A method of detecting upstream signal transmission quality of a cable modem, the method comprising:

assigning a first time slot to the cable modem in which the cable modem can transmit data upstream;

reserving a second time slot, unassigned to a particular cable modem;

informing an FFT generator of the first time slot and of the second time slot;

generating one or more FFT measurements of an upstream spectrum during the first time slot and the second time slot; and

comparing FFT measurements of the first time slot with FFT measurements of the second time slot thereby detecting undesirable noise created by the cable modem.

2. A method as recited in claim 1 further comprising informing the upstream receiver of the first time slot and the second time slot.

3. A method as recited in claim 1 wherein a MAC unit assigns the first time slot and reserves the second time slot.

4. A method as recited in claim 1 wherein the FFT measurements are of the entire upstream spectrum.

5. A method as recited in claim 1 wherein generating one or more FFT measurements of an upstream spectrum further includes creating one or more frequency-power spectrum graphs.

6. A method as recited in claim 1 wherein comparing FFT measurements of the first time slot with FFT measurements of the second time slot further includes calculating the difference between two FFT measurements.

7. A method as recited in claim 6 wherein calculating the difference between two FFT measurements further includes taking the difference between the power level of a first FFT point in a first FFT measurement and the power level of a corresponding FFT point in a second FFT measurement.

8. A method as recited in claim 1 wherein comparing FFT measurements of the first time slot with FFT measurements of the second time slot further includes creating a power-difference FFT measurement.

9. A method as recited in claim 1 further comprising incrementing a sampling counter after every second FFT measurement and using the sampling counter to determine whether more FFT measurements are needed.

10. A method as recited in claim 6 further including calculating an average difference of a plurality of differences between two FFT measurements.

11. A method as recited in claim 1 further comprising calculating power differences between the FFT measurement taken during the first time slot and the FFT measurements taken during the second time slot.

12. A method as recited in claim 11 further comprising determining whether any of the power differences are greater than a predetermined threshold power ratio.

Sub A 13. A method as recited in claim 12 further comprising informing a MAC unit to not assign a time slot to the cable modem if any of the power differences are greater than the predetermined threshold power ratio.

14. A method as recited in claim 11 wherein calculating power differences further includes calculating power differences between pairs of corresponding FFT points taken from FFT measurements of the first time slot and FFT measurements of the second time slot.

Sub A3

15. A cable modem termination system (CMTS), the CMTS capable of detecting faulty cable modems, the CMTS comprising:

an upstream receiver and demodulator capable of receiving an upstream signal;

a Fast Fourier Transform (FFT) engine capable of performing FFT measurements on the upstream signal and storing the FFT measurements; and

a processor for performing computations on the FFT measurements and communicating data, wherein the data relates to noise levels of the upstream signal at predetermined times.

16. A CMTS as recited in claim 15 further comprising:

an anti-alias filter including a low-pass filter; and

an analog/digital converter capable of converting an analog signal to a digital signal.

17. A CMTS as recited in claim 15 wherein the FFT engine further includes a field programmable gate array (FPGA) configured to perform an FFT.

18. A CMTS as recited in claim 17 wherein the FPGA further includes a processor interface for communicating data to a processor.

19. A CMTS as recited in claim 15 wherein the FFT engine further comprises memory units for storing twiddle factors and intermediate data for use in an FFT measurement.

20. A CMTS as recited in claim 15 wherein the FFT engine is located outside a headend of a cable television plant.

21. A method of detecting a faulty cable modem in a cable television plant, the method comprising:

taking a first FFT measurement of an upstream spectrum, creating a first frequency-power spectrum, at a time when a cable modem is transmitting data upstream;

taking a second FFT measurement of the upstream spectrum, creating a second frequency-power spectrum, at a time when no data is being transmitted upstream;

calculating a power-difference between the first FFT measurement and the second FFT measurement; and

utilizing the power-difference to determine whether the cable modem is faulty.

22. A method as recited in claim 21 further comprising allocating a dummy time slot in which no data is transmitted upstream in the cable television plant.

23. A method as recited in claim 21 further comprising informing an FFT generator of the time when no data is being transmitted upstream and of the time when a cable modem is transmitting data upstream.

24. A method as recited in claim 21 wherein calculating a power-difference further comprises calculating the difference between corresponding FFT points in the first frequency-power spectrum and in the second frequency-power spectrum.

25. A method as recited in claim 21 wherein utilizing the power-difference to determine whether the cable modem is faulty further comprises comparing the power-difference with a threshold power level.

26. A method as recited in claim 25 wherein the threshold power level is 15 dB for QPSK modulation and 25 dB for QAM16 modulation.

Sub B4

27. A method of detecting faulty modems in a network employing multiple channels, separated in frequency to allow modems to transmit data, the method comprising:

for a selected modem transmitting data in a frequency channel, comparing extra-channel noise outside the frequency channel when it is transmitting data with a noise floor outside the frequency channel when the select modem is not transmitting data; and

if the difference between the extra-channel noise when the modem is transmitting and when the modem is not transmitting is greater than a predetermined threshold, disabling the selected modem.

28. A method as recited in claim 27 wherein comparing the extra-channel noise is performed by comparing frequency-power spectrums at two different predetermined times known to correspond to times when the selected modem is transmitting and when the selected modem is not transmitting, respectively.

29. A method as recited in claim 27 wherein the network is a cable television plant and the modems are cable modems.

30. A method as recited in claim 27 wherein the predetermined threshold is 15 dB for QPSK modulation and 25 dB for QAM16 modulation.

31. A computer program product for detecting upstream signal transmission quality of a cable modem, the computer program product comprising:

a computer code that assigns a first time slot to the cable modem in which the cable modem can transmit data upstream;

a computer code that creates a second time slot, unassigned to a particular cable modem;

a computer code that informs an FFT generator of the first time slot and of the second time slot;

a computer code that generates one or more FFT measurements of an upstream spectrum during the first time slot and the second time slot;

a computer code that compares FFT measurements of the first time slot with FFT measurements of the second time slot thereby detecting undesirable noise created by the cable modem; and

a computer-readable medium that stores the computer codes.

32. A computer program product for detecting faulty modems in a network employing multiple channels, separated in frequency to allow modems to transmit data, the computer program product comprising:

a computer code that compares, for a selected modem transmitting data in a frequency channel, extra-channel noise outside the frequency channel when the selected modem is transmitting data with a noise floor outside the frequency channel when the selected modem is not transmitting data;

a computer code that disables the selected modem if the difference between the extra-channel noise when the selected modem is transmitting and when the selected modem is not transmitting is greater than a predetermined threshold; and

a computer-readable medium that stores the computer codes.